III. Remarks

A. Status of Official Action Dated August 11, 2011

The Action dated August 11, 2011 to which this Paper is responsive is marked "Final" in the Office Action Summary. However, Applicants understand that this Action is non-final based on (i) the status in PAIR ("NON FINAL ACTION MAILED") and (ii) the June 9, 2011 Interview Summary, which states, "The final rejection is vacated and the Examiner will issue a new non-final rejection."

B. Amendments to the Claims

Pending claims 6, 7, 13 and 14 have been canceled, leaving claims 1, 8-9, 12, 15-16 and 17-23. Of these claims, claims 1, 8-9, 12, and 15-16 are amended and claims 17-23 remain unchanged.

Throughout the claims, the term "gradation" has been changed to "brightness". Brightness is a concrete form of gradation in the present invention, and this term is used in Paragraph [0072] and other places in the specification.

Claim 1 has also been amended, with respect to the evaluation means, to make clear that the evaluation means makes the evaluation on the basis of the corrected brightness of a particular region of the picture of the mandible in the X-ray picture.

Claim 8 has been amended to make it clear that the display means displays the corrected brightness of the particular region of the picture of the mandible in the form of a histogram. This amendment is supported by, for example, the description in Paragraph [0178] and FIG. 38.

Claim 9 has been amended to state that the judging means judges the level of the bone mineral density. The amendment is supported by, for example, the description in Paragraph [0014] and [0177] and FIG. 38.

In addition to amendments similar to those made to claim 1, claim 12 has been amended to make it clear that the correcting means corrects the brightness of the X-ray picture such that

the average value of the brightness of the picture of the artificial reference specimen as detected by the detecting means becomes equal to the preset standard average value and such that the deviation of the brightness of the picture of the artificial reference specimen becomes equal to the preset standard deviation.

The amendments to claims 15 and 16 are the same as the amendments made to claims 8 and 9, respectively.

C. Claim Rejection under 35 U.S.C. § 103

1. Claims 1, 8-10 and 21-23

The Action rejects claims 1, 6-10 and 21-23 as being obvious from Yamashita (JP 62-266053) in view of U.S. Published Patent Application No. 2001/0021269 to Inoue. Claims 6 and 7 have been canceled, rendering the rejection of those claims moot. Reconsideration and withdrawal of the rejection of the remaining claims are respectfully requested in view of the foregoing amendments and the following arguments.

The inventor, seeing correlation existing between the bone mineral density of a human mandible and the bone mineral density of the human body, made the invention defined by the independent Claim 1 of the present application to quantitatively evaluate the bone mineral density of the entire body on the basis of the brightness of the X-ray picture of the mandible. However, the brightness of an X-ray picture of a mandible varies depending on various conditions under which the X-ray picture is taken. Accordingly, for quantitatively evaluating the bone mineral density of the body on the basis of the brightness of the picture of the· mandible, it is required to correct or normalize the brightness of the X-ray picture of the mandible with respect to a predetermined reference so that a predetermined relationship can be established between the brightness of the X-ray picture of the mandible and the bone mineral density of the body (or the mandible).

According to claim 1, the X-ray picture contains, in addition to the picture of the mandible, a picture of a reference specimen that is artificial and, therefore, whose material,

shape, dimensions etc. are known. Detecting means is used to detect the brightness of a particular portion of the picture of the artificial reference specimen. Ideally, the brightness of the particular portion of the picture of the artificial reference specimen as detected by the detecting means has a given value. The brightness of the X-ray picture including the particular portion of the picture of the artificial reference specimen is corrected by correcting means such that the brightness of the particular portion of the picture of the artificial reference specimen becomes equal to the preset reference value, i.e. the ideal value. The brightness of the particular portion of the picture of the artificial reference specimen is used as an index. The brightness of the X-ray picture as a whole is corrected in such a manner that the brightness of the particular portion of the picture of the artificial reference specimen acting as an index has the ideal value, which precisely normalizes the brightness of the whole X-ray picture.

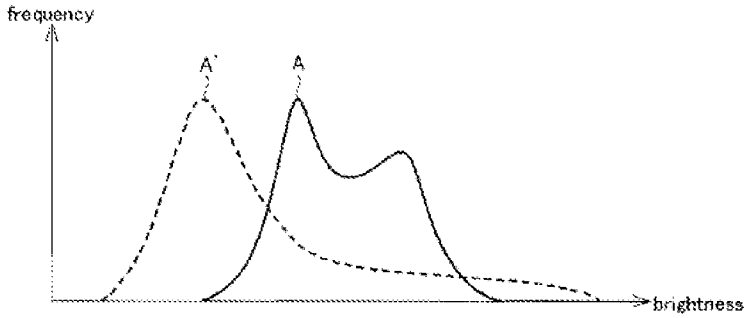
The evaluation of the bone mineral density can be made accurately by the evaluating means on the basis of the brightness of a particular region of the picture of the mandible in the precisely normalized X-ray picture.

Yamashita discloses an arrangement in which a picture of an aluminum staircase as a reference material is disposed beside a picture of a mandible in an X-ray picture (Page 3, Lines 13-20 and Fig. 1). Yamashita also states that the densitometry of the aluminum staircase at its almost center portion is measured (Page 4, Lines 18-21 and Fig. 1). Also, Yamashita discloses evaluation of the degree of alveolar bone atrophy using three indices d, $\sum$ GS and GSmax (Page 5, Lines 25-31). However, Yamashita neither discloses nor suggests any element corresponding to the correcting means recited in claim 1 of the present application.

The Action finds that Inoue (Paragraphs [0047]-[0057] and FIG. 1) discloses an element corresponding to the correcting means recited in claim 1. However, the correction made in Inoue is what is known as histogram conversion, which is completely different processing from the correction made by the claimed correcting means of claim 1. According to Inoue, histogram conversion is performed to make the histogram of the X-ray dose (pixel value) of the input picture (the picture of a particular portion of an x-rayed subject, i.e., a human body) coincide

with the histogram of the X-ray dose of the target picture (the picture in the ideal state) of the same particular portion of the X-rayed subject. Inoue discloses that its histogram conversion makes the picture of the particular portion of the X-rayed subject more easily observable to the naked eye of an observer.

The Applicants will briefly explain the histogram conversion of Inoue with reference to Applicant's illustrative Reference FIG. 1 presented below.



Reference Fig.1 Inoue(US2001/0021269)

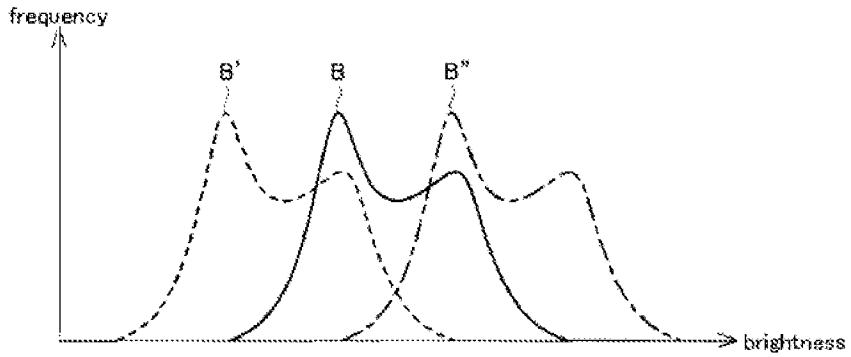
With reference thereto, let it be assumed that a solid line curve A is a histogram of the X-ray dose of the picture of the particular portion of the x-rayed subject, and a broken line curve A' is a histogram of the X-ray dose of an ideal picture of the particular portion of the x-rayed subject. According to the histogram conversion of Inoue, the pixel value of the input picture (i.e., the X-ray dose of the picture of the particular portion of the subject) is corrected in such a manner that the histogram A of the pixel value of the input picture can coincide with the histogram A' of the pixel value of the target picture. As a result, even if there is a correlation between the pixel value of the input picture before the correction (i.e. before the histogram conversion) and the bone mineral density of the particular portion of the x-rayed subject, the correlation between the pixel value of the input picture after the correction (i.e., after the histogram conversion) and the bone mineral density of the particular portion of the x-rayed subject collapses.

Accordingly, adoption of the histogram conversion of Inoue for Yamashita can only make the histogram of the picture of the mandible in the X-ray picture of Yamashita coincide

with the ideal histogram. In other words, such combination simply makes the picture of the mandible more easily observable to an observer. The pixel value of the picture of the mandible after the histogram conversion is no longer correlated with the bone mineral density of the mandible, and therefore it is impossible to quantitatively evaluate the bone mineral density from the pixel value of the picture of the mandible when combining the teachings of Yamashita and Inoue.

Applicant also notes that Inoue neither discloses nor suggest the use of an element corresponding to the artificial reference specimen recited in claim 1 of the present application. As such, it is not known how the histogram conversion of Inoue can be used in Yamashita. If the histogram conversion suggested by Inoue can be applied at all to the picture of the aluminum staircase in the X-ray picture of Yamashita (i.e., if the histogram conversion is performed to make the histogram of the aluminum staircase coincident with the ideal histogram), then the picture of the aluminum staircase would become more observable to an observer. But it is not known how the histogram conversion could be done for the pictures other than the picture of the aluminum staircase, and, in particular, for the picture of the mandible. And if, for example, the histogram conversion is such that the histogram of the picture of the mandible becomes coincident with the ideal histogram of the picture of the aluminum staircase, then the picture of the mandible after the histogram conversion is absolutely different from the picture before the histogram conversion. This makes it impossible to quantitatively evaluate the bone mineral density using the pixel value of such picture of the mandible.

According to claim 1 of the present application, when the correction by the correcting means is done, any histogram of the brightness of the entire X-ray picture including a particular region of the picture of the mandible to be evaluated would simply slide along the horizontal axis (brightness axis) with its shape maintained, resulting in a broken line curve 8' or a dot-and-dash line curve 8" as illustrated in Applicant's illustrative Reference FIG. 2 below.



Reference Fig.2 Present Invention

Accordingly, the correlation between the brightness of the picture of the mandible and the bone mineral density of the mandible (or the entire body) is maintained, which makes it possible to quantitatively evaluate the bone mineral density.

As elaborated above, the combination of Yamashita with Inoue cannot provide the invention defined by Claim 1 of the present application. The combination does not provide any operable means for enabling quantitative evaluation of bone mineral density. Neither Yamashita nor Inoue discloses or suggests any element equivalent to the correcting means recited in claim 1 of the present application that can be used for achieving the claimed bone mineral density quantitative evaluation.

For at least the foregoing reasons, Applicant submits that claim 1 is not obvious from the combination of Yamashita and Inoue and is, therefore, in allowable form. Claims 6-10 and 21-23, which are directly or indirectly dependent from Claim 1, are also allowable at least by virtue of their dependence on claim 1.

2. Claims 12 and 15-20

The Action rejects claims 12-14 and 16-20 as being obvious from Yamashita in view of of U.S. Patent No. 6,078,686 to Kim. Claims 13 and 14 have been canceled, rendering the rejection thereof moot. Reconsideration and withdrawal of the rejection of the remaining claims are respectfully requested in view of the foregoing amendments and the following arguments.

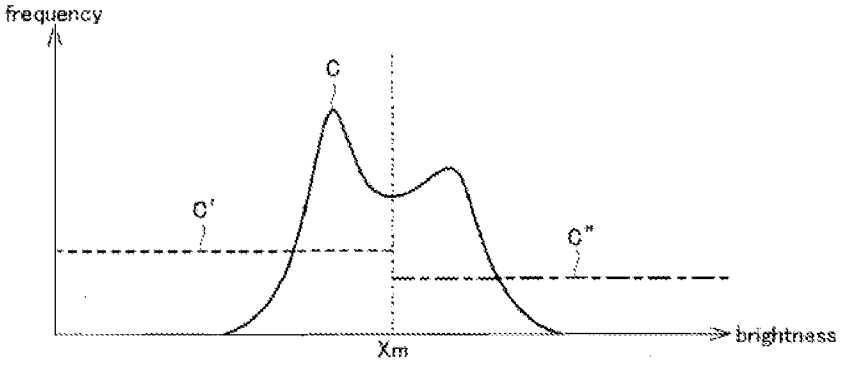
Like claim 1, independent claim 12 defines an invention for quantitatively evaluating the bone mineral density of an entire human body on the basis of the brightness of an X-ray picture of a mandible and is founded on the inventor's observation that a correlation exists between the bone mineral density of a human mandible and the bone mineral density of the human body. Like the evaluation system of claim 1, an X-ray picture contains a picture of a mandible and a picture of an artificial reference specimen disposed beside the picture of the mandible. However, the brightness of the picture of the artificial reference specimen of claim 12 differs from place to place. Detecting means detects the average value and deviation of the brightness of the artificial reference specimen. It should be noted that the "deviation" referred to herein is what is commonly or academically called "standard deviation". This is clear from the Expression 6 of Paragraph [0058] of the specification of this application. Each of the average value and deviation as detected by the detecting means is ideally constant. The brightness of the entire X-ray picture is corrected by the correcting means in such a manner that the average value as detected by the detecting means becomes equal to a preset or ideal average value (referred to in the claims as "preset standard average value") and that the deviation as detected by the detecting means becomes equal to a preset or ideal deviation (referred to in the claims as the "preset standard deviation"). It should be noted that the "standard deviation" referred to here is the standard for the "deviation" (without the term "standard") referred to above and in the claim, and, therefore, is different from the commonly used term "standard deviation".

By using the average value and deviation of the brightness of the picture of the artificial reference specimen as indices and correcting the brightness of the entire X-ray picture in such a manner that the average value and deviation become equal to the respective ideal values (i.e., "preset standard average value" and "preset standard deviation"), the brightness of the entire X-

ray picture can be precisely normalized. The evaluating means can then be used to evaluate accurately the bone mineral density on the basis of the brightness of a particular region of the picture of the mandible in the brightness normalized X-ray picture.

Yamashita neither discloses nor suggests any element corresponding to the detecting means (for detecting the average value and deviation of the brightness of the picture of the entire artificial reference specimen) and the correcting means. The Action relies on Kim (Column 8, Line 36 to Column 10, Line 38, and Fig. 4 of KIM) as disclosing elements corresponding to the claimed detecting means and correcting means recited in claim 12. However, Kim detects the mean level X_m of the entire picture and two cumulative density function (CDF) $c_L(X_k)$ and $c_U(X_k)$ separately calculated with the mean level Xm used as the boundary, which are absolutely different from the average value and deviation of the brightness of the artificial reference specimen detected by the detecting means of claim 12 of the present application. Further, the correction made in Kim is what is called histogram equalization, and is a processing totally different from the correction made by the correcting means of claim 12.

Moreover, according to Kim, the brightness of the original picture is divided into two areas with the mean level Xm being used as the boundary, and histogram equalization being provided separately on the respective two brightness area. Applicant illustrates this point using Applicant's illustrative Reference FIG. 3 printed below.



Reference Fig.3 Kim(US6,078,686)

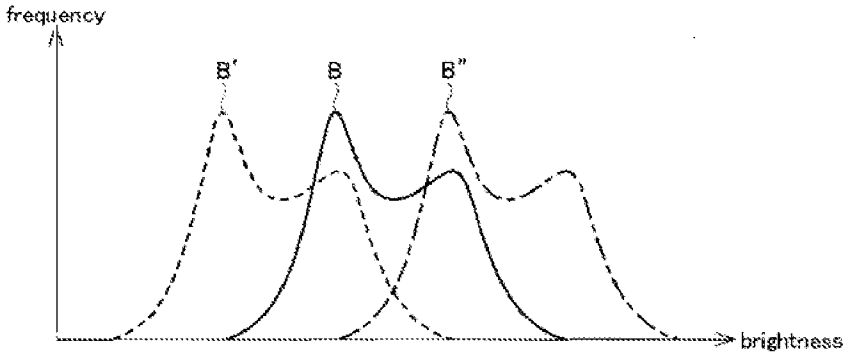
As illustrated in Reference FIG. 3, according to the histogram equalization of Kim, the histogram C of an original picture is equalized separately in the lower brightness side and the higher brightness side areas adjacent to each other with the mean level Xm in between. As a result, both the lower brightness side histogram C' and the higher brightness side histogram C" have shapes different from the histogram C of the original picture. The Action states that, according to Kim, by adopting such histogram equalization picture quality improvement can be realized over the area from the lower brightness side area to the higher brightness side area.

Per the foregoing discussion, even if the histogram conversion as disclosed by Kim is used for Yamashita, the only result is separate equalization of the histogram of the picture of the mandible in the X-ray picture of Yamashita in a lower brightness side area and a higher brightness side area. In other words, the only result is the picture quality improvement realized over the lower brightness side and higher brightness side areas. But the result of this processing is that the brightness of the picture of the mandible after the histogram conversion no longer correlates with the bone mineral density of the mandible, and therefore it is absolutely impossible to quantitatively evaluate the bone mineral density on the basis of the brightness of the picture of the mandible.

Applicant should also note that Kim, like Inoue, neither discloses nor suggests the use of an element corresponding to the artificial reference specimen recited in claim 12 of the present application. As such, it is not known how the histogram conversion of Kim can be used in Yamashita. If the histogram conversion suggested by KIM can be applied to the picture of the aluminum staircase in the X-ray picture of Yamashita (i.e., if the histogram conversion is performed to equalize the histogram of the aluminum staircase separately for a lower brightness side area and a higher brightness side area), then the picture quality may or may not be improved over the lower to higher brightness side areas. And it is not known how the histogram conversion can be done for the pictures other than the picture of the aluminum staircase, and, in particular, for the picture of the mandible. If, for example, the histogram conversion is such that the histogram of the picture of the mandible, too, is equalized separately in the lower brightness side and higher brightness side areas, the only result is picture quality improvement over the

lower to higher brightness side areas. With this conversion it is impossible to quantitatively evaluate the bone mineral density on the basis of the brightness of the mandible resulting from such histogram equalization.

When the correction is provided by the correcting means recited in claim 12, as with the correction provided by the correcting means of claim 1, the histogram B of the brightness of the entire X-ray picture including a particular region of the picture of the mandible to be evaluated simply slides along the horizontal axis (brightness axis) with its shape maintained, resulting in a broken line curve S' or a dot-and-dash line curve S", as illustrated in Applicant's illustrative Reference FIG. 2 shown above and reprinted below.



Reference Fig.2 Present Invention

Accordingly, the correlation between the brightness of the picture of the mandible and the bone mineral density of the mandible (or the entire body) is maintained, which makes it possible to quantitatively evaluate the bone mineral density.

As elaborated above, the combination of Yamashita with KIM cannot quantitatively evaluate the bone mineral density based on the brightness of the picture of the mandible and thus does not provide the invention defined by claim 12. Further, neither Yamashita nor KIM discloses or suggests elements corresponding to the detecting means and the correcting means of claim 12, which form means for realizing the quantitative evaluation of bone mineral density. Therefore, for at least the foregoing reasons, Applicants submit that claim 12 is not obvious from

and is allowable over the combination of Yamashita and Kim. Claims 15-20 depend directly or indirectly from claim 12 are also in allowable form. Reconsideration and withdrawal of the rejection of these claims are respectfully requested.

IV. Conclusion

In view of the foregoing remarks and amendments, Applicant submits that this application is in condition for allowance at an early date, which action is earnestly solicited.

The Commissioner for Patents is hereby authorized to charge any additional fees or credit any excess payment that may be associated with this communication to deposit account **04-1679**.

Respectfully submitted,

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/joseph a. powers/
Joseph A. Powers, Reg. No.: 47,006
Attorney For Applicant

DUANE MORRIS LLP
30 South 17th Street
Philadelphia, Pennsylvania 19103-4196
(215) 979-1842 (Telephone)
(215) 979-1020 (Fax)